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Project Report on Need to Extension of National Highways for 4lanes to 6lanes

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ABSTRACT:

The Government of India has decided to upgrade 6500 km length of existing 4-lane divided highways into Six-Lane divided carriageway under Phase-V of National Highway Development project (NHDP). The Phase-V of NHDP is to be executed as BOT (Toll) Project through Public Private Partnership (PPP) on Design-Build-Finance-Operate (DBFO) pattern. The National Highways Authority of India (NHAI) has appointed BCEOM Societe Francaise d'Ingenierie, France in Association with BCEOM India Pvt. Limited, presently known as Egis India Consulting Engineers Pvt Ltd., as consultants to carry out Feasibility study for upgrading the existing four lane highway to Six-Lane access control highway from Chilakaluripet-Eluru-Rajahmundry section of NH-5 under DBFO pattern, for which the consultants have completed the study and submitted the final feasibility report. The new Six-Lane facility would be an access controlled highway through provision of service roads, pedestrian and cattle underpass, vehicular underpasses, grade separators, exit/entry ramps etc. The objective is to enhance operational efficiency of highway and safety of the traffic & the road users. The stretch from Vijayawada to Chilakalurpet has been prioritised by NHAI for which tenders have been called and the work has been awarded on DBFOT pattern. The feasibility report has been reframed for the balance stretch from Vijayawada to Rajahmundry. Subsequently consultants were instructed to carryout feasibility study for providing bypass for Vijayawada and Hanuman Junction city and a letter to this effect has been issued to the Consultants by NHAI to initiate the studies as an additional work. The consultant has submitted draft feasibility report for Vijayawada bypass. The present report has been prepared combining the earlier feasibility report and the feasibility studies carried on the bypasses as draft combined Feasibility Report for 103.590Kms length of a section of NH-5 from Vijayawada Bypass (Km

0+000 to Km 47+880), Vijayawada (Km 1076+480) to Hanuman Junction (Km 1060+800), Hanuman Junction Bypass (Km 0+000 to Km 6+720) and Hanuman Junction (Km 1055+650) to Gundugolanu (Km 1022+480) in the state of Andhra Pradesh.

INTRODUCTION:

National Highway 5 (NH-5) is a major National Highway in India that runs along India's east coast through the states of Orissa, Andhra Pradesh and Tamil Nadu. The northern terminal is at Jharpokharia in Orissa and the southern terminal is at Chennai in Tamil Nadu. NH 5 is a part of the golden quadrilateral project undertaken by National Highways Development Project. Under the new national highway numbers NH 5 is renamed as NH 16. NH 5 runs for a distance of 1533 km. In Tamil Nadu NH 5 starts from Chennai and shortly enters Andhra Pradesh from Gummidipundi. The intention of this specific consultancy project is to study and report on the feasibility of retrofitting the existing NH-5 from Vijayawada-Eluru-Gundugolanu from its existing situation [a bypasses and 4-lane highway of about 103.580 Km in length] to a 4-lane and 6-lane highway. The objectives of the consultancy services are to prepare a proposal to retrofit a six-lane cross-section on to the existing 4-lane highway in a manner which ensures:

- Enhanced safety of the traffic, the road users and the people living close to the highway.
- Enhanced operational efficiency of the highway.
- Fulfillment of the access needs of the local population.
- Minimal adverse impact on the road users and the local population due to construction. Feasible and constructible options for the project with least cost options.

Inception Report

The Inception Report was the first significant report to be submitted under this Study as per Terms of Requirements (TOR), and was submitted in the month of December 2006 (Vijayawada-Gundugolanu section), July 2010 (Vijayawada Bypass) and August 2010 (Hanuman Junction Bypass). The report focused on:

- Reporting on start of the consulting services (information retrieved, mobilisation)
- The definition of the objectives of the project

 The identification of likely issues and constraints

 Methodology to achieve the Study Objective

Draft Feasibility Study Report

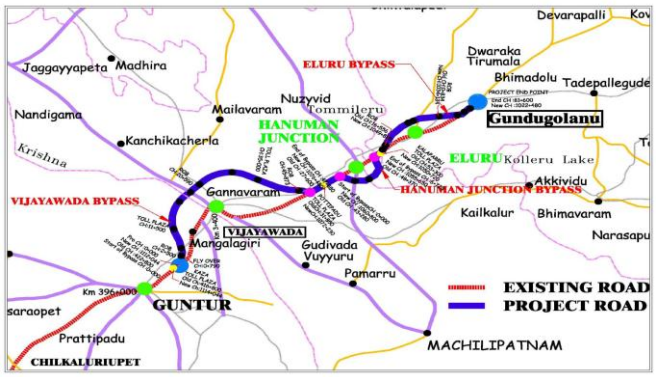
The Draft Feasibility Report is essentially presents the facility planning with options and alternatives for 6 laning of existing 4 lane project highway, which was submitted in the month of February 2006 (Vijayawada-Gundugolanu section) and December 2010 (Vijayawada Bypass).

Final Feasibility Study Report

The Final Feasibility Report presents the facility planning with options and alternatives for 6 laning of existing 4-lane Project Highway after exhaustive discussions with the NHAI and the revised guidelines issued by NHAI.

Recent NHAI Initiative

Recently NHAI has issued the advertisement for finalizing the consultants to work on the proposed bypass for the Vijayawada and Hanuman Junction city under NHDP, Phase-V. Keeping in view of the proposed bypass, no elevated structures like flyovers were proposed within the city limits of Vijayawada and Hanuman Junction city. Provision of such structures will make the project unviable once the proposed bypass comes into existence. Also keeping in view the present and future projected traffic, four and six laning is proposed with minimum length of service roads.



Project Location Map, Vijayawada Bypass (47.88 Km), Vijayawada-Gundugolanu section (48.99Km) and Hanuman Junction Bypass (Km 6.72)

RECENT HISTORY OF THE ROAD AND RELEVANT DOCUMENTS

Relevant documents

The Consultant has collected as-built drawings (both in electronic form and hard copy), DPR & other secondary relevant documents (in hardcopy) from NHAI. The chainages on the old NH-5 followed a different chainage system. Old NH-5 had different sections, i.e., Chennai-Vijayawada, Vijayawada-Visakhapatnam etc. Each section had different set of chainages. The NHAI has issued a circular stating that new

chainage for NH-5 will start from the Baharagora (near Kolkata) to Chennai under Golden Quadrilateral project. Under this circular, the chainage from Kolkata to Chennai was changed, and the new system of chainage has been adopted. The correlation with the new chainages and old chainages were developed and these chainage equations were incorporated in the as built Drawings. Chainage equations were developed due to the construction of new bypasses along the project highway. For easy reference the chainage equations and the correlation between the old and as-built chainages along the project highway is given in Table 0.1 below.

Chainage Equations

From	To	Length (km)	Section
Km 0+000 (Existing NH-5 Chainage Km 422+800,New Ch 1112+044)	Km 47+880 (Existing NH-5 Chainage Km 1076+480)	47.88	Proposed Vijayawada Bypass
Km 1076+480	Km 1060+800	15.68	Gannavaram-Hanuman Junction (Existing NH-5)
Km 0+000 (Existing NH-5 Chainage Km 1060+800)	Km 6+720 (Existing NH-5 Chainage Km 1055+650)	6.72	Proposed Hanuman Junction Bypass
Km 1055+650	Km 1022+480	33.17	Hanuman Junction-Gundugolanu (Existing NH-5)
Total length (km)		**103.59**	

The old 2-Lane NH-5 has been upgraded to 4-Lane divided carriageway in the year of 1997-2003 under Golden quadrilateral project. The length of the project works out to be 103.590 Km as per the as-built and the DPR chainages. An inventory was carried out by hand held GPS to understand the chainage variation in each kilometre. The chainage is increasing from Vijayawada to Gundugolanu as per the as-built chainage of NH-5 (from Kolkata to Chennai). The project starts at Km 0+000 to Km 47+88 (Vijayawada Bypass), Km 1076+480 to Km 1060+800 (Gannavaram to Hanuman Junction section), Km 0+000 to Km 6+720 (Hanuman Junction Bypass), Km 1055+650 after Hanuman Junction city limits and ends at Km 1022+480 (Gundugolanu).

Existing Situation on NH-5

This section of National Highway No. 5 was widened over the period 2001 to 2006 from 2 to 4 lanes. The majority of the widening was as per the NHDP programme and the above work also involved in developing seven new bypasses around densely populated urban areas. There is no service roads exist along the existing project highway. There are about 155 median openings existing on the project road. There are many side road accesses to the highway. There are no "access control" measures in place, and as such many buildings/factories etc are built [and still being built] with direct access to NH-5.

Recent history

The existing road before taking up 4-laning works consist of 2-lane carriageway of width varying from 6.5 to 7m except for some isolated built-up section where the carriageway width varies from 10 to 14m. The existing pavement is of flexible type with thin bituminous surfacing at the top developed since ages.

Traffic Survey

The traffic surveys conducted to study the project influence area and to meet the objectives of the study & TOR requirements. The surveys have been conducted in the month of December 2006 and January 2007 (for Vijayawada-Gundugolanu section). The main traffic surveys are as below:

- Classified Traffic Volume Count Survey for 7 days
- Origin-Destination Survey for 24hrs
- Turning Movement Count for 12 Hrs
- Pedestrian Count Survey for 12 hrs
- Speed and Delay Survey on project corridor and on alternate corridor

The project highway has been divided into following three traffic homogeneous sections:

- Vijayawada Bypass comprising of section 1 & 2,
- Vijayawada bypass to Gundugolanu,

The salient findings of the traffic volume count surveys are as below:

- Average Daily Traffic (ADT) in base year 2010 minimum is 21714 (Tollable PCUs)

and 25005 total PCUs in Vijayawada Bypass to Gundugolanu section.

- The share of non motorised vehicles is very less at 2.66%.

Traffic Growth rates

The traffic growth rates adopted for the project highway are finalized based on the past

trend analysis and analysis of the economic indicators of the project influence area and presented below:

Traffic Growth Rates

Period	Two Wheeler	Car	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/ EME
2011-15	8.7	7.0	5.5	5.5	6.6	6.6	6.6	6.6	6.6	6.6
2016-20	7.1	6.5	5.5	5.5	6.6	6.6	6.6	6.6	6.6	6.6
2021-25	5.3	6.0	5.0	5.0	6.1	6.1	6.1	6.1	6.1	6.1
>2025	5.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Traffic Projection for Capacity Analysis

For capacity and level of service analysis, the AADT observed on the Project Road has been projected **with 5% growth rate** and presented below:

Projected Traffic for the Western Alignment Section 1

Year	Car/ Jeep/ Van	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/ EME	Total PCUs
2010	353	-	-	328	1,103	1,287	147	-	-	8,677
2015	453	-	-	418	1,408	1,643	188	-	-	11,079
2020	579	-	-	533	1,798	2,097	239	-	-	14,139
2025	739	-	-	680	2,294	2,676	306	-	-	18,046
2030	944	-	-	868	2,927	3,417	391	-	-	23,038
2035	1,205	-	-	1,108	3,735	4,361	501	-	-	29,410
2040	1,537	-	-	1,413	4,767	5,565	639	-	-	37,528
2045	1,962	-	-	1,804	6,084	7,102	816	-	-	47,898

Projected Traffic for the Western Alignment Section 2

Year	Car/ Jeep/ Van	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/ EME	Total PCUs
2010	620	-	-	247	1,739	811	162	-	-	9,370
2015	792	-	-	315	2,220	1,036	207	-	-	11,964
2020	1,012	-	-	402	2,834	1,322	264	-	-	15,271
2025	1,293	-	-	512	3,617	1,687	337	-	-	19,490
2030	1,651	-	-	654	4,616	2,154	432	-	-	24,886
2035	2,108	-	-	835	5,891	2,750	552	-	-	31,768
2040	2,690	-	-	1,066	7,519	3,510	705	-	-	40,549
2045	3,434	-	-	1,361	9,597	4,480	900	-	-	51,757

Traffic Projections for the portion from Vijayawada Bypass to Gundugolanu

Year	Car/ Jeep/ Van	Mini Bus	Bus	LCV	2 Axle Truck	3 Axle Truck	MAV up to 6 Axle	MAV >6 Axles	HCM/ EME	Two Wheeler	Auto Rickshaw	Tempo	Agri Tractor	Agri Tractor & Trailor	Animal Hand drawn	Cycle	Cycle Rickshaw	Others	Tollable Traffic PUCs	Total PCUs
2010	3,016	56	1,167	568	1,667	2,521	377	-	-	2,873	663	610	17	64	7	339	24	2	21,714	25,005
2015	3,849	71	1,489	725	2,128	3,217	482	-	-	3,667	846	779	22	82	7	434	29	2	27,714	31,901
2020	4,912	91	1,899	925	2,715	4,106	615	-	-	4,680	1,079	994	27	105	7	554	38	2	35,364	40,694
2025	6,270	117	2,424	1,181	3,466	5,241	785	-	-	5,973	1,379	1,269	34	134	7	708	48	2	45,143	51,932
2030	8,003	149	3,093	1,507	4,424	6,689	1,001	-	-	7,624	1,760	1,619	44	171	7	903	62	2	57,610	66,263
2035	10,213	190	3,948	1,923	5,646	8,537	1,278	-	-	9,729	2,246	2,066	56	218	7	1,152	79	2	73,527	84,553
2040	13,035	244	5,039	2,454	7,205	10,896	1,631	-	-	12,416	2,867	2,637	71	278	7	1,472	101	2	93,842	107,900
2045	16,637	311	6,432	3,132	9,195	13,907	2,082	-	-	15,847	3,659	3,365	91	355	7	1,878	129	2	119,773	137,702

IRC: 64 - 1990 stipulates a design service volume of 40,000 PCU per day for a four lane divided carriageway with paved shoulders at level of service B and plain terrain. This can be further increased upto 60,000 PCUs by adopting LOS C. The Vijayawada bypass crosses 40,000 PCUs in the year 2042 and 2040 for the sections 1 & 2 respectively. Hence it may be prudent to consider them for four laning only. The section between Vijayawada bypass to Gundugolanu reaches 40,000 PCUs in the year 2020 and 60,000 PCUs in the year 2028. Hence it is necessary to consider it for 6 laning now itself.

DESIGN STANDARDS FOR BRIDGES/STRUCTURES

The cross drainage structures shall be classified as culverts, minor bridges and major bridges depending up on the length of structure as per IRC standards. Structures up to 6m length fall into the category of culverts, more than 6m and up to 60m in length as minor bridges and beyond this as major bridges. The design standards and loading to be considered for culverts, bridges, underpasses, flyovers and ROB's shall be those laid down in the latest IRC codes and/or IS codes. Where the said codes are found wanting or are silent other codes at national or international level shall be followed in consultation with the client. ROBs shall be planned and designed in consultation with the concerned Railway Authorities.

1. The Indian Road Congress (IRC) codes will be the basis of bridge designs, underpasses and flyover/ ROB's. For items not covered by latter, provisions of Special Publications and Specification for Roads and Bridges published by IRC shall be followed.

2. Grades of Concrete for superstructures will be as per MOST Specifications and IRC

Standards. The Minimum grade shall be M40 for PSC and M30 for RCC respectively.

3. For all new 3-lane structures, 3-lane live load will be considered as per IRC-6.

4. Locations of new Minor Bridges will generally be guided by the alignment of the highway. But, for major bridges, the bridge location and its alignment shall override the highway requirement in that portion.

5. On economic considerations and for ensuring good riding quality, wherever possible, for the new bridges the layout of the existing bridges having a number of small spans will be modified by decreasing the number of spans, maintaining the piers parallel and in line with those of the existing structure.

6. The deck will have 2.5% unidirectional camber/cross fall and the wearing course will be of uniform thickness of 15 mm Mastic and 50 mm BC. For high traffic density, thickness of mastic and BC shall be 25 mm and 40 mm respectively.

7. In general it has been observed during the preliminary study that the type foundations for the existing bridges have not suffered any distress.

8. Pile foundations may be adopted for flyovers and ROB structures, depending on the properties of the strata based on sub-soil investigation reports to be carried out by Concessionaire.

Width of New Bridges

NHAI / 4 laning and 6 laning manual guidelines are to be followed.

Flyovers

Where flyovers are proposed, minimum vertical clearance above the cross roads will be 5.0 m. Where viaducts [continuous] are proposed and the intent is to also use the road under for vehicular traffic [as in a 4 lane continuous viaduct with the current road retained under] then all the structure vertically above the roadway under should have the 5.0 m clearance [and this includes the underside of the crossheads on the columns].

Planning for New Bridges

In general, the following aspects are taken into account while planning for the new bridges and structures:

- Proper siting of bridge and geometrics of approaches;
- Linear waterways and minimum vertical clearances;

 Satisfactory geological conditions;

 Aligning the piers with those of the existing structure to avoid cross currents and obstruction to flow;

 Minimum distance from the existing structure consistent with construction requirements and hydraulic consideration;

 Modular approach in design for both superstructure and substructures;

 Minimum number of spans consistent with road deck levels and minimum vertical clearance above design HFL

 Continuity (Except deck continuity) to be provided in superstructure for better riding quality.

Planning for New Culverts

For culverts, following guidelines will be followed:

(a) For culverts in new carriageway, minimum span and vent height will be kept equal to that of those in the existing carriageway; raising of deck level according to highway alignment will be made wherever required.

(b) Weak and non-functional culverts to be dismantled and new culverts to be constructed with carriageway and median matching with highway plan and profile.

(c) For central widening to three lane, new abutments will be provided on both sides of the existing culverts. Existing slab to be dismantled and new slab with specified camber to be cast for the full length.

(d) Culverts in service road locations to be extended up to the road side longitudinal drain.

(e) In new alignments and bypasses, sufficient numbers of balancing culverts are to be provided wherever alignment crosses through flat agricultural fields and lies in close vicinity to high embankments of railways and flood bunds.

(f) In case of culverts whose bed and floor have scoured off severely and considerable afflux is observed, the same will be replaced with new culverts having adequate vents or with a minor bridge, based on adequate hydrological studies.

(g) Culverts will be designed for IRC Class-A / Class-70R Tracked / Class-70R Wheeled Loading as per relevant IRC Codal Provisions.

(h) Culverts shall be constructed for full formation width of the roadway.

(i) For pipe culverts, expansion chambers shall be provided at median/ between main carriageway and service road for proper maintenance.

(j) All cross drainage pipe culverts with less than 900 mm diameter shall be replaced with new 1.2 m (minimum) diameter pipe culverts.

(k) All new pipe culverts shall be of minimum 1.2 m diameter.

Repair / rehabilitation of existing bridges

Repair and rehabilitation of existing bridges shall be carried out by a specialised agency. Before taking up any repair (except for items essential for road user safety/ make safe items), a project level investigation shall be carried out for finding out the cause of distress and to suggest the rehabilitation / strengthening measures required.

PAVEMENT & MATERIALS INVESTIGATIONS AND DESIGN

Pavement design basically aims at determining the total thickness of the pavement structure as well as the thickness of the individual structural components for carrying the estimated traffic loading under the prevailing environmental condition and adopted maintenance strategy with satisfactory performance of the pavement will result in higher savings in terms of Vehicle operating costs and travel time. Many design methods, from purely empirical to rigorous analytical ones are available, and these are practiced in different parts of the world. In our country, the generally adopted method of design of flexible pavement is the one recommended in IRC: 37-2001, Guidelines for the Design of Flexible Pavements, is also an analytical method of pavement design. For the effective design of pavement, rehabilitation proposals, there must needs to assess the availability & suitability of potential construction material sources in the project vicinity. Various engineering surveys and materials investigation has been carried out as part of feasibility study and were discussed in the following sections. This section presents the pavement and materials investigations followed by design process and the resulting design recommendations.

Pavement Condition Survey

The visual pavement condition survey was carried out using Viziroad equipment along the project road. The equipment is composed of

- A laptop computer with 2 additional keyboards of 24 key each.

- A distance sensor connected to the gearbox of the vehicle

- A 12 channel GPS

- A Digital video camera; plus

- A Bump Integrator for the roughness measurements

The Viziroad software was used for data acquisition in terms of distress levels, process and corrects the raw data for assessment of visual pavement condition functionally.

The equipment was set up for logging the following defects elements and data:

Longitudinal cracking in 3 levels

Rutting/Deformations in 3 levels

Alligator cracking in 3 levels.

Patching in 3 levels.

Potholes in 3 levels

Stripping in 3 levels

Transverse cracking in 3 levels.

Border erosion in 3 levels

DRAFT FEASIBILITY STUDY REPORT

The Draft Feasibility Study Report was submitted in early February 2007 (Vijayawada-Gundugolanu), December 2010 (Vijayawada Bypass) and January 2011 (Hanuman Junction Bypass).

This Final Feasibility Report is essentially an update of the Draft report, with one scheme for 4/6 laning presented.

ACCIDENTS AND ROAD SAFETY

The study identified projects such as crash barriers, improvements to lane markings, signage etc and the recommendations of this study are under implementation. The project corridor is proposed for improving to a six laning with access control and enhanced safety.

Wrong Side Driving

It has been observed that driving on the wrong side is a more prominent and common problem on the project road. Further to it, driving in the fast lane is more common than using the shoulder portion. This is a major issue which could result in more severe accidents. The photographs present some cases of wrong side driving. Such unexpected traffic situations on the road result in avoidable accidents.

Over Loading

The overloading of vehicles is another problem on the project road and results in the poor visibility for the traffic. Such overloading is more prominent in case of slow and agricultural vehicles. This would not only obstruct the visibility but also reduce the lane width available for vehicles overtaking and affect the level of service on the project road. The photographs below exhibit some overloaded vehicles observed on the project road.

Uncontrolled accesses

There are many access points on to the project road and there is no control over the traffic entering the project corridor. Most of the intersections are uncontrolled and those in the urban areas are controlled through fixed time traffic signals or by police in the peak periods




The above photographs present some typical intersections on the project corridor. Such uncontrolled intersections pose a threat to safe movement of traffic on high speed corridors. These need to be addressed while upgrading the project corridor to a six lane access control facility.

Pedestrian Interference

There are a number of settlements along the project road. Though the share of pedestrian involved accidents is low but the interference with traffic is considerable. The following photos illustrate the pedestrian interference with fast motorised traffic. Such interference will also affect the smooth flow of traffic and may some times lead to accidents often fatal. Though there are pedestrian over bridges at few locations, these are not being used and have now become a rest place or restroom.

Head Light Glare

There is no provision made to counter/ address the head light glare. This problem is more pronounced in the night time. Even in cases where a 5m median exists, due to the absence of shrubs or anti glare screen in the median, the visibility is affected. Only at few places in urban areas median railings are provided for short lengths.

Other Issues

The road is much less safe currently than it should be for the following reasons:

 There is no access control [except where some frontage roads are provided, generally in towns] – the road has far too many access points [so you can and do drive straight into a high speed road.

 The road mixes short distance [very local – including animals herded on the road in more rural areas] and long distance traffic so there are many movements [entering the road, U turning in the medians, driving the wrong way down the road1, grazing in the median] which are incompatible with the high speed long distance facility this road is supposed to provide.

 The main junctions [mostly at grade] have poor advance signing, and should be grade separated.

 Little thought has been given in villages and towns crossed as to how the local population crosses the main National Highway [other than by praying first then running very quickly].

 There is no existing highway traffic management system.

 Guardrail [and barriers at approach to some bridges] is lacking in places, and hanging loose in others.

CONCLUSION AND RESULTS OF PRESENT STUDY

in project we known to raise transport capacity and alleviate traffic congestion by widening the national highway 5 (nh-5) from a road between gundugolanu and vijayawada in andhra pradesh state , thereby contributing to regional economic growth and enhanced safety of the traffic, the road users and the people living close to the highway also observed the enhanced operational efficiency of the highway. The fulfillment of the access needs of the local population are studied and minimal adverse impact on the road users and the local population due to construction**.**

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